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Model 413A

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ISOLATED POWER SYSTEM ANALYZER

1978

413A

OPERATING and SERVICE MANUAL

NEURODYNE-DEMPSEY, Inc.
Carson City, Nevada

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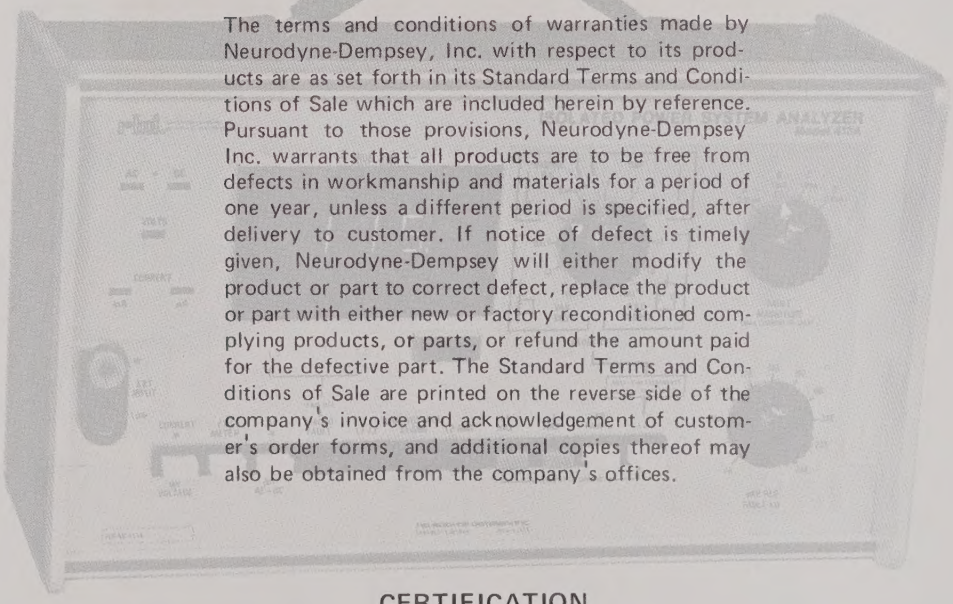

CERTIFICATION

This instrument was thoroughly tested and inspected and found to meet our manufacturing specifications as published, when it was shipped from the factory.

We further certify that our calibration measurements are traceable to the U.S. National Bureau of Standards as applicable.

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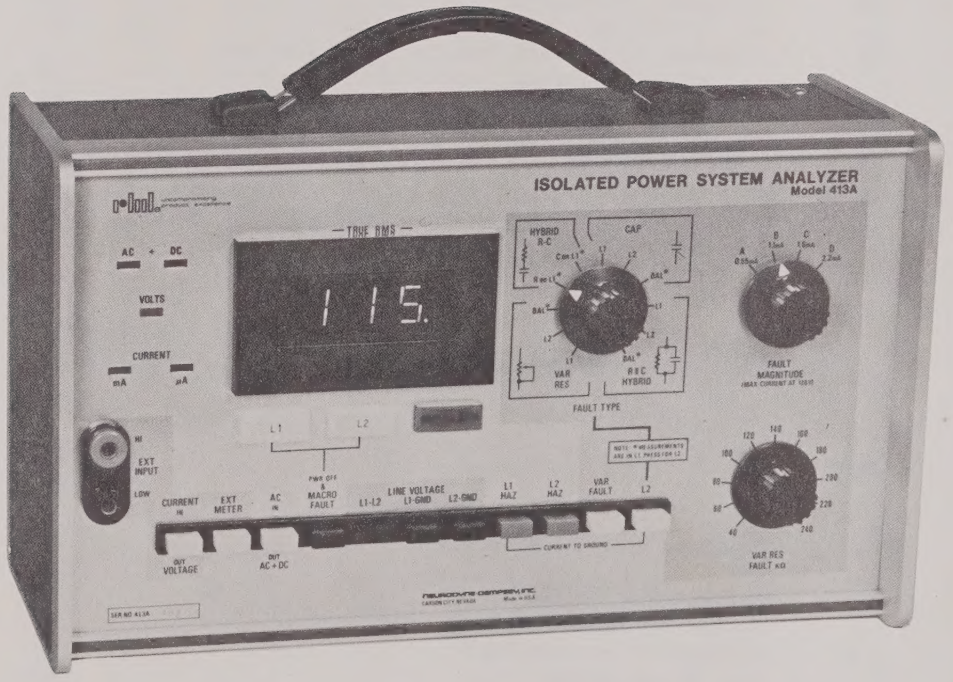

FIGURE 1.1 Isolated Power System Analyzer, Model 413A

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general information

1.1 ■ INTRODUCTION

1.2 This manual contains operating and maintenance instructions for the Model 413A Isolated Power System Analyzer.

1.3 ■ DESCRIPTION

1.4 The Model 413A is an instrument designed to check the operation of an isolated power system and line isolation monitor. The 413A is capable of checking the isolated power system for macro faults, line voltage, line balance, hazard current, and the trip level current of the line isolation monitor by simulating possible malfunctions that could develop in the isolated power system.

1.5 ■ SWITCHING CIRCUITS

1.6 Power and signal switching is accomplished with push-button and rotary switches.

1.7 ■ METERING CIRCUITRY

1.8 The metering circuitry used in the Model 413A is all solid state. The multimeter is a three digit, four function digital meter. The four functions are: AC volts, AC+DC volts, AC current, and AC+DC current. Each function has a corresponding light-emitting diode (LED) indicator that indicates the mode of operation.

1.9 ■ SPECIFICATIONS

1.10 Specifications of the Model 413A are shown in Table 1-1.

1.11 ■ ACCESSORIES

1.12 A red coiled test lead, stock number 9501-0039, and a black coiled test lead, stock number 9501-0040, are included as standard accessories.

1.13 Test forms, number 413A-SS-1026, are available for the Model 413A. Our stock order number is 9510-0017. A sample form is included in the appendix of this manual.

TABLE 1-1 Specifications for the Model 413A

ELECTRICAL

RANGES:	
VOLTAGE	0-100 V and 0-1000 V.
CURRENT	0-990 μA and 0-10 mA.
METER: [Two Range Auto-Ranging]	Upranges at approx. 99%. Downranges at approx. 10%.
FUNCTION:	
AC + DC	Responds to true RMS value of AC and DC signals.
AC	Responds to true RMS value of AC signals.
ACCURACY:	
EXTERNAL METER	±1% DC to 20 KHz and ±5% 20 KHz to 100 KHz.
INTERNAL CURRENT LOAD:	100 Ω in parallel with 0.15 μf. Per UL 1022.
TEMPERATURE COEFFECIENT:	±0.01% / °C.
TEMPERATURE RANGE:	
OPERATING	15 °C to 35 °C.
STORAGE	-20 °C to 60 °C.
POWER REQUIREMENTS:	
VOLTAGE	115 V ±10%, 50-60 Hz.
CURRENT	50 mA max.

PHYSICAL CHARACTERISTICS

FINISH:	Vinyl-covered aluminum with photo-etched and anodized front panel. Machined and anodized side plates.
DIMENSIONS:	29.21 x 17.30 x 11.27 cm. [11-1/2 x 6-13/16 x 4-7/16 ins.]
WEIGHT:	2.16 Kg. [4-3/4 lbs.]

notes

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installation

2.1 ■ INTRODUCTION

2.2 This section contains information for making a visual and electrical inspection of the instrument, processing a claim, repackaging for shipment, and installation procedures.

2.3 ■ INCOMING INSPECTION

2.4 This instrument was carefully inspected both mechanically and electrically before shipment. Upon receipt, the instrument should be inspected for in-transit physical damage and the electrical performance should be tested using the procedure outlined in Paragraph 5.4 of Section V.

2.5 ■ CLAIMS

2.6 If physical damage is found or if operation is not within specifications when the instrument is received, notify the carrier immediately. Please read the sheet on damage and shortage at the back of this manual. If Neurodyne-Dempsey, Inc., or their factory representative is notified, arrangements can be made for the repair or replacement of the instrument without waiting for the carrier to settle the claim. A new Purchase Order will need to be issued for this work as this is not covered under warranty repair.

2.7 ■ WARRANTY REPAIR

2.8 The warranty statement for all Neurodyne-Dempsey's equipment is on the back of the title page of this manual.

2.9 The warranty does not cover the cost of transportation. No C.O.D. shipments will be accepted without prior authorization. All transportation and phone charges will be billed to the customer.

2.10 It is recommended that United Parcel Service or Air Parcel Post be used to return the instrument to the factory. Please follow the guidelines given in Paragraphs 2.12 thru 2.13 when packaging the instrument to avoid further delay or damage.

2.11 ■ REPACKAGING FOR SHIPMENT

2.12 When shipping an instrument to Neurodyne-Dempsey, attach a tag describing required services and include model number, serial number, and return address.

2.13 The following is a general guide for repackaging an instrument for shipment:

a) Place instrument in original container if available.
b) If original container is not available, use a heavy carton or wooden box as a container and use strong tape or metal bands to seal it.
c) Wrap instrument in heavy paper or plastic before placing in container.
d) Use at least four inches of tightly packed, industry-approved, shock-absorbing material around the instrument.
e) Mark the shipping container "Delicate Instrument", "Fragile", etc.

2.14 ■ PREPARATION FOR USE

2.15 The Model 413A is a portable instrument and is ready for use as shipped from the factory. The unit is intended to be used on an isolated three-wire 120 volt AC 60 Hz single phase power system. The unit can also be used on a grounded power system when the external meter function is to be used.

notes

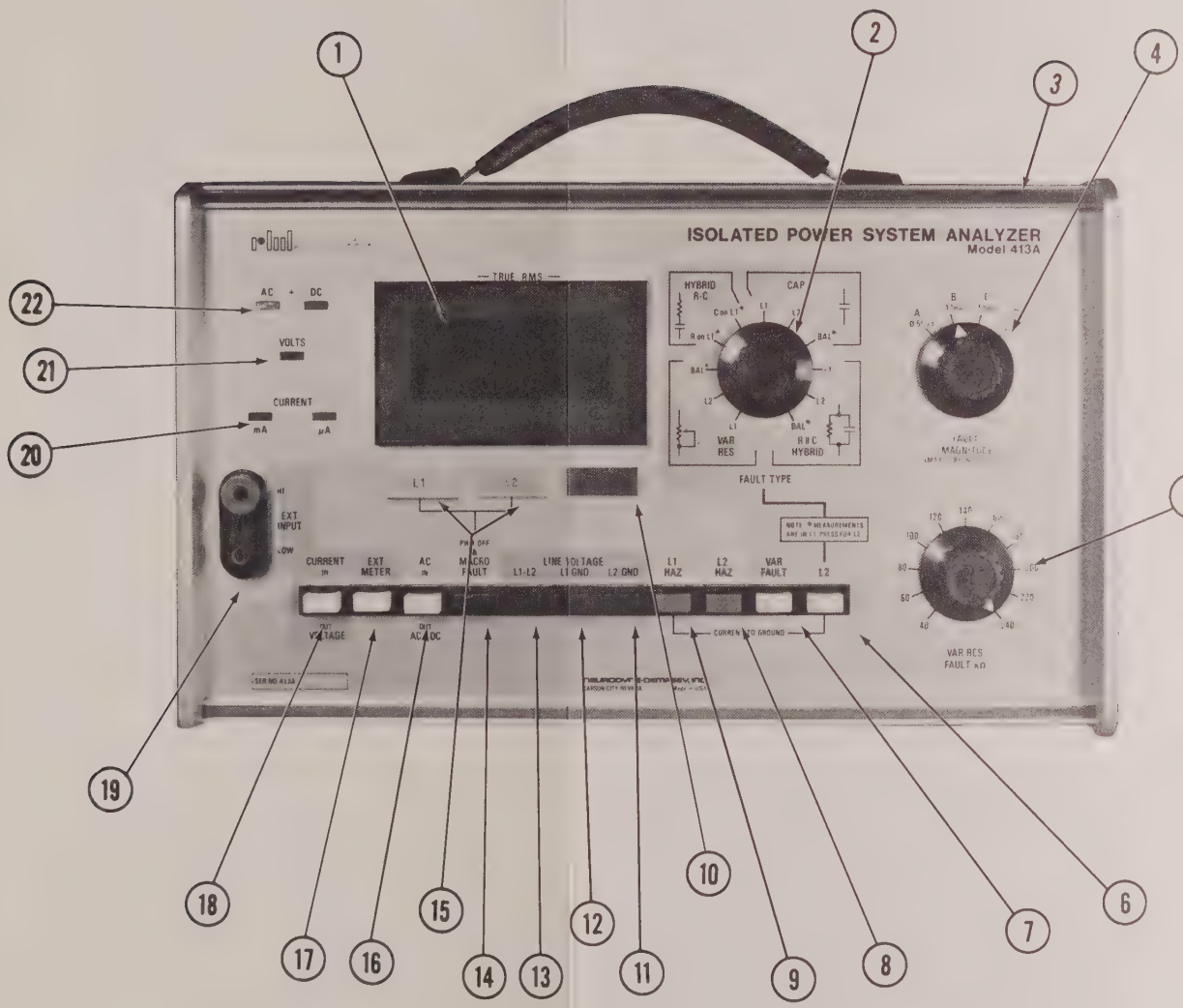

FIGURE 3.1 Operating Controls and Functions of Model 413A

1) **DISPLAY** . . . . . Three digit display (true RMS value).

2) **FAULT TYPE Selector** . . . Selects various fault impedances.

3) **POWER RECEPTACLE** . . . AC power input.

4) **FAULT MAGNITUDE Selector** . Selects magnitude of fault impedances when FAULT TYPE selector is in HYBRID R-C, CAP, and R||C HYBRID positions.

5) **VAR RES FAULT KΩ Selector** . Varies FAULT MAGNITUDE when FAULT TYPE selector is in VAR RES position. (Spring return.)

6) **L2 Pushbutton** . . . . . Provides for measurement of current through fault on line 2 when in * position.

7) **VAR FAULT Pushbutton** . . Provides for selection of variable fault mode operation.

8) **L2 HAZ Pushbutton** . . . . Measures line 2 hazard current to ground.

9) **L1 HAZ Pushbutton** . . . . Measures line 1 hazard current to ground.

10) **OVERLOAD Lamp Indicator** . Illuminates when there is an overload on the input of the metering circuitry.

11) **LINE VOLTAGE, L2-GND Pushbutton** . . . . . Measures voltage between line 2 and ground.

12) **LINE VOLTAGE, L1-GND Pushbutton** . . . . . Measures voltage between line 1 and ground.

13) **LINE VOLTAGE, L1-L2 Pushbutton** . . . . . Measures voltage between line 1 and line 2.

14) **PWR OFF and MACRO FAULT Pushbutton** . . . . AC power on/off. Indicates Macro Fault in "power off" position either on L1 or L2 lamp indicators.

15) **L1 and L2 Lamp Indicators** . . Illuminate when a Macro Fault exists on line 1 or line 2 respectively.

16) **AC/AC+DC Pushbutton** . . . Selects either AC or AC+DC display.

17) **EXT METER Pushbutton** . . Selects external meter operation thru EXT INPUT jacks.

18) **CURRENT/VOLTAGE Pushbutton** . . . . . Selects the mode of external meter operation.

19) **EXT INPUT Jack** . . . . . Provides for external use of the meter.

20) **CURRENT mA-μA LED's** . . Illuminate to indicate current range of digital display on meter.

21) **VOLT LED** . . . . . Illuminates to indicate digital display in voltage mode on meter.

22) **AC+DC LED's** . . . . . Illuminate to indicate type of voltage displayed on digital meter.

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operation

3.1 ■ INTRODUCTION

3.2 The Model 413A Isolated Power System Analyzer enables the user to thoroughly evaluate the performance of an isolated power system. The tests made are: Macro Fault, Line Voltage, L1 Hazard, L2 Hazard, and Var Fault.

3.3 The instrument was human-engineered so the tests can be performed in a rapid and efficient sequence. See Figure 3.1 for a description of the controls and indicators.

3.4 ■ TESTING OF AN ISOLATED POWER SYSTEM

3.5 Connect the power cord of the Model 413A to the Isolated Power System to be tested. Proceed with the testing as described below. Record the data on Form 413A-SS-1026 (a sample form is located in the appendix of this manual). The stock number for the form is 9510-0017.

3.6 ■ MACRO FAULT TEST

3.7 This test gives a quick check of the isolated power system to determine if a gross fault might exist.

3.8 Press the MACRO FAULT pushbutton in until it locks. If either L1 or L2 are at or near ground, the appropriate indicator will be illuminated. For purposes of this test, a Macro Fault is defined as a voltage greater than 95 V ±2 between a line and ground. Even though a MACRO FAULT light is illuminated, the isolated power system may be operating correctly. To determine if it is, proceed with the following line voltage test.

3.9 ■ LINE VOLTAGE TEST

3.10 This test measures the voltage between line 1 and line 2, line 1 and ground, and line 2 and ground.

3.11 Press the L1-L2, LINE VOLTAGE pushbutton until it locks. Read the voltage between line 1 and line 2 on the meter.

3.12 Press and hold in the L1-GND pushbutton. Read the voltage between line 1 and ground on the meter. The voltage should be approximately 60 volts with a well balanced system. Release the L1-GND pushbutton.

3.13 Repeat Paragraph 3.12 for L2-GND measurements.

3.14 ■ HAZARD CURRENT TEST

3.15 This test measures the worst case leakage current for line 1 and for line 2. This leakage current is called the HAZARD CURRENT.

3.16 Press and hold in the L1 HAZ pushbutton. Read the leakage current from line 1 to ground on the meter. This reading should be low with a well isolated power system. The alarm on the power system should sound when the test is performed. Release the L1 HAZ pushbutton.

3.17 Repeat Paragraph 3.16 for the L2 HAZ test.

3.18 ■ VARIABLE FAULT TEST

3.19 This test measures the fault current required to sound the alarm in the isolated power systems. Four types of faults are used in an unbalanced and a balanced connection to thoroughly test the line isolation monitor.

NOTE

The FAULT TYPE switch has five positions with an asterisk. In these positions the meter indicates the current through the fault connected to line 1. To measure the current flowing through the fault connected to line 2, press the L2 pushbutton.

3.20 VARIABLE RESISTANCE FAULT

3.21 Press the VAR FAULT pushbutton in until it locks. Select the VAR RES, L1, position on the FAULT TYPE switch. Rotate the spring loaded VAR RES FAULT potentiometer counter-clockwise until the alarm sounds. After recording the trip level meter reading, release the potentiometer.

3.22 Proceed with the testing, going to VAR RES, L2, and BAL.

3.23 Before proceeding with the following test, check that the FAULT MAGNITUDE switch is in position A. This will prevent any unnecessary sounding of the alarm on the isolated power system.

3.24 HYBRID R-C FAULT

3.25 Select the HYBRID R-C, R on L1* position of the FAULT TYPE switch.

3.26 Rotate the FAULT MAGNITUDE from position A until the alarm sounds. Record the readings in the designated section of the Test Form by circling the letter corresponding to the FAULT MAGNITUDE switch setting and record the meter reading. Circle the applicable current multiplier. Return the FAULT MAGNITUDE switch to position A and repeat this step with the L2 pushbutton depressed. Record these readings on the Test Form for L2.

3.27 Select the HYBRID R-C, C on L1* position of the FAULT TYPE switch. Repeat step 3.26, but record the readings on the C in the L1 section.

3.28 CAPACITIVE FAULT

3.29 Select the CAP, L1, L2, and BAL* positions in turn on the FAULT TYPE switch. Measure the alarm current for each position by rotating the FAULT MAGNITUDE switch until the alarm sounds. Insure that the L2 pushbutton is depressed for the BAL, L2, reading. After recording the meter reading and FAULT MAGNITUDE switch position, return the switch to position A.

3.30 R || C HYBRID FAULT

3.31 Select the R || C HYBRID, L1, L2, and BAL* positions respectively on the FAULT TYPE switch. Measure the alarm current for each position by rotating the FAULT MAGNITUDE switch until the alarm sounds. After recording the meter reading and FAULT MAGNITUDE switch position, return the switch to position A.

3.32 ■ EXTERNAL USE OF METER

3.33 The meter with it's two voltage and current ranges can be used as a general purpose meter. Press the EXT METER pushbutton. Select the current or voltage mode as desired. Connect the test leads to the EXT INPUT jack and meter is ready for use.

3.34 ■ SIGNAL SEPARATION

3.35 The meter can be set up to measure AC signals or AC+DC signals. In both cases the meter indicates the true RMS value of the waveform. For the AC+DC case the reading is:

$$\sqrt{(dc)^2 + (acRMS)^2}$$

3.36 Using the two modes it can be determined if the signal being measured is an AC signal, a DC signal, or a combination of both.

principles of operation

4.1 ■ GENERAL

4.2 This section contains an overall description of the operation of the Model 413A. Refer to the block diagram shown in Figure 4.1 and schematic diagram in Section V while reading the text.

4.3 ■ GENERAL THEORY

4.4 Following is an explanation of circuit operation based on the block diagram in Figure 4.1, and all the schematics in Section V. The data is provided for a basic understanding of the instrument.

4.5 There are four tests that the Model 413A Isolated Power System Analyzer performs:

1) Macro Fault test.
2) Line Voltage test.
3) Total Hazard Current test.
4) Variable Fault tests.

4.6 ■ MACRO FAULT TEST

4.7 Macro faults are detected by means of neon lamps. Each line of the isolated power system is connected to a neon lamp. When a macro fault occurs, a neon lamp will illuminate. A macro fault is defined as a voltage greater than 95 V ±2 between line and ground.

4.8 ■ LINE VOLTAGE TEST

4.9 The LINE VOLTAGE test provides the capability of measuring voltage in the isolated power system between line 1 and line 2, line 1 and ground, and line 2 and ground. The AC+DC or AC select pushbutton switch can also be used in conjunction with these tests to determine if any DC is being measured. Refer to the schematic diagram for further details.

4.10 ■ HAZARD CURRENT TEST

4.11 The hazard current is the total leakage current of line 1 measured by connecting a 100 ohm resistor in series with a current meter from line 2 to ground. The reverse connections measure the hazard current of line 2.

4.12 ■ VARIABLE FAULT TESTS

4.13 The VARIABLE FAULT tests determine the line isolation monitor trip points. Balanced and unbalanced fault impedances are checked with FAULT TYPE switch through HYBRID R-C, CAPACITIVE, and R ll C HYBRID loads. In addition, a variable resistive fault is provided to measure the trip level for each side of the line (and line balance) in the VAR RES position of switch. In the HYBRID R-C, CAP, and R C HYBRID positions of FAULT TYPE switch, loads may be progressively increased through FAULT MAGNITUDE switch.

4.14 ■ METERING CIRCUITRY

4.15 The Model 413A metering circuitry is contained on three subassemblies - A1, A2, and A5. A1 is the analog board, A2 is the range indicator board, and A5 is a digital panel meter (DPM) which converts the DC output of A1 to the digital readout.

4.16 The circuitry is solid state and consists of the following main functions. See Block diagram, Figure 4.1.

1) High input impedance amplifier.
2) RMS to DC converter.
3) Analog to digital converter readout.
4) Auto-ranging circuit.
5) Logic circuitry for decimal point and function indication.
6) Power supply.

4.17 The input amplifier is a Bi-FET amplifier. This unit uses junction field-effect transistors as an input stage and Bi-polar transistors for the output stage.

4.18 The RMS to DC converter is a single integrated circuit which contains all the circuitry necessary to perform the analog computation to compute the RMS value of the waveform.

4.19 The DC output from the RMS to DC converters is fed to a D.P.M. which performs the analog to digital conversion and displays the result.

4.20 The auto-ranging circuitry uses an OP-AMP to compare the output of the RMS to DC converter against a reference voltage and changes the gain of the input amplifier.

4.21 The logic circuitry takes a signal from the auto-ranging and switching circuitry and displays the range the meter is on while controlling the decimal point.

4.22 The power suppliers are standard full-wave rectifiers with capacitor input filters and single voltage integrated circuit regulators that supply +5 V, -5 V, +12 V, and -12 V DC.

notes

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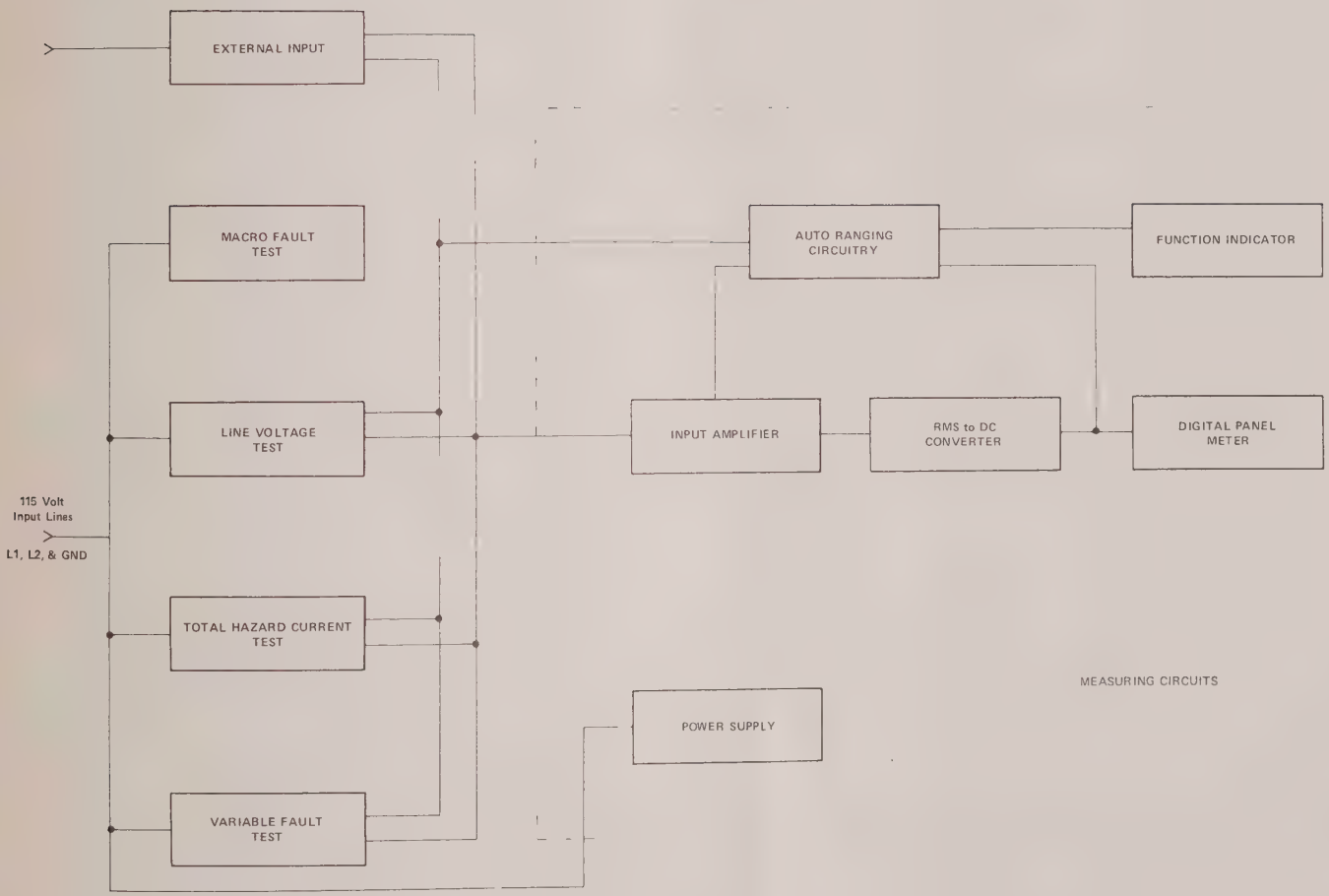

FIGURE 4.1 Overall Block Diagram

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performance check & calibration

5.1 ■ INTRODUCTION

5.2 This section contains performance tests, calibration procedures, and troubleshooting procedures. The performance tests are designed to verify the critical specifications listed in Table 1-1. The calibration procedure describes the necessary steps to adjust the parameters within the specifications limits. The troubleshooting procedure aids in isolating problems.

5.3 ■ TEST EQUIPMENT REQUIRED

5.4 Equipment required for the performance test and adjustment procedure is listed in Table 5-1, Recommended Test Equipment. Equipment that satisfies the characteristic specifications given in the table may be substituted for a recommended model.

TABLE 5-1 Recommended Test Equipment

EQUIPMENT	CHARACTERISTIC	TYPICAL
Variable Transformer	1 amp capacity	Superior Electric Model 2PF10
Digital Multimeter (DMM)	3 digit with 0.5% accuracy AC and DC	Systron Donner Model 7004
AC/DC voltage and current source	Voltage output adjustable between 0 and 250 V. Current output adjustable between 10 and 1000μA 0.2%, DC, 0.4% AC.	Hewlett-Packard Model 6920B
D.P.D.T. Switch	Used for Phase reversal.	

5.5 ■ PERFORMANCE TEST

5.6 AC AMMETER ACCURACY TEST

5.7 An AC Current Standard is required for this test.

a) Connect the Model 413A to a 115 V supply. Set pushbutton switches to EXT METER, CURRENT, and allow to warm up for ten minutes.

b) Connect the AC Current Standard to the EXT INPUT jacks. Set the output to the values listed in Table 5-2. The Model 413A display should be within the values listed.

TABLE 5-2 AC Ammeter Accuracy Values

INPUT	READING	INPUT	READING
9.9 mA	9.85-9.95 mA	900 μA	895-905 μA
9.0 mA	8.95-9.05 mA	800 μA	795-805 μA
8.0 mA	7.95-8.05 mA	700 μA	695-705 μA
5.0 mA	5.95-5.05 mA	500 μA	495-505 μA
4.0 mA	3.95-4.05 mA	400 μA	395-405 μA

5.8 AC VOLTMETER ACCURACY TEST

5.9 An AC Voltage Standard is required for this test.

a) Switch the EXT METER function from CURRENT to VOLTAGE.

b) Connect the Voltage Standard to the EXT INPUT jacks and set the output to the values listed in Table 5-3. The Model 413A display should be within the values listed.

TABLE 5-3 AC Voltmeter Accuracy Values

INPUT	READING	INPUT	READING
500 V	495-505 V	90 V	89.5-90.5 V
300 V	295-305 V	70 V	69.5-70.5 V
100 V	95-105 V	50 V	49.5-50.5 V
		30 V	29.5-30.5 V

5.10 ■ ADJUSTMENT PROCEDURE

CAUTION

ADJUSTMENT PROCEDURES ARE INTENDED FOR QUALIFIED SERVICE PERSONNEL ONLY. TO REDUCE THE POSSIBILITY OF ELECTRICAL SHOCK, ONLY QUALIFIED PERSONNEL ARE TO PERFORM MAINTENANCE DUTIES.

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5.11 The following procedures should be performed only after it has been determined from the performance test that the Model 413A does not meet specifications. If any adjustment in these procedures cannot be made, refer to the troubleshooting procedure. Location of the adjustments are shown in Figure 5.4.

5.12 Remove the two screws in the rear panel and slide the cover off the instrument.

5.13 READOUT ZERO ADJUSTMENT

5.14 The readout is zeroed by connecting a jumper wire across the input of the DPM and adjusting the ZERO control for 000 on the display.

a) Remove the display bezel by pulling on the button lip.
b) Connect a jumper between TP-7 and TP-8 on A1.
c) Energize the Model 413A and allow to warm up for five minutes.
d) Adjust the ZERO control for a display of 000.
e) Remove the jumper and replace the bezel.

5.15 INPUT AMPLIFIER ZERO ADJUSTMENT

5.16 A digital multimeter (DMM) is required for this adjustment.

a) Set the DMM to 100 mV DC voltage range.
b) Connect the HI and LOW leads to TP-5 and TP-8 on A1 respectively.
c) Adjust A1R5 until the DMM displays zero ±0.5 millivolt.

5.17 GAIN ADJUSTMENT

5.18 An AC Current Standard is required for this adjustment.

a) Set the switches on the Model 413A to EXT METER and CURRENT.
b) Set the AC Current Standard to 9.00 mA RMS 60 Hz and connect to the EXT INPUT jacks.
c) Adjust A1R8 for a display of 9.00. Verify the mA indicator is illuminated.
d) Set the AC Current Standard to 900 μA RMS.
e) Adjust A1R10 for a display of 900. Verify the μA indicator is illuminated.

5.19 AUTO RANGING ADJUSTMENT

5.20 An AC Current Standard is required for this adjustment.

a) Apply a 1.0 mA 60 Hz input from the Current Standard. This will place the Model 413A in the high range.
b) Reduce the input to 0.90 mA. Adjust A1R16 to down-range at this point.
c) Increase the current to 990 μA. Adjust A1R15 to up-range at this point.

5.21 MACRO FAULT VOLTAGE ADJUSTMENT

5.22 A Variac and DMM are required for this adjustment.

a) Connect the Model 413A to the Variac. Push the MACRO FAULT switch.
b) Set the output of the Variac to 92 V using the DMM.
c) Select a resistance value for A3R13 so that L1 Macro Fault light is just illuminated.
d) Reverse the hot and neutral connections to power cord. Select a resistance value for A3R14 so that L2 Macro Fault light is just illuminated.

5.23 ■ TROUBLESHOOTING

5.24 If the Model 413A operates incorrectly and the trouble cannot be corrected by the Adjustment Procedure, the following troubleshooting information should be used. Check for loose wires or other obvious sources of trouble, such as burned or loose components. Make sure that printed circuit boards are seated firmly in connectors, and integrated circuit packages are firmly seated in sockets.

5.25 The problems that might occur can be isolated to specifice functions by analyzing the symptoms. After isolating the problem, the schematics will help in locating the faulty component.

5.26 The following procedure can be used to isolate a faulty component in the metering circuitry A1, A2, and A5:

a) Measure the power supply voltages using a DMM. They should be within the values listed in Table 5-4.

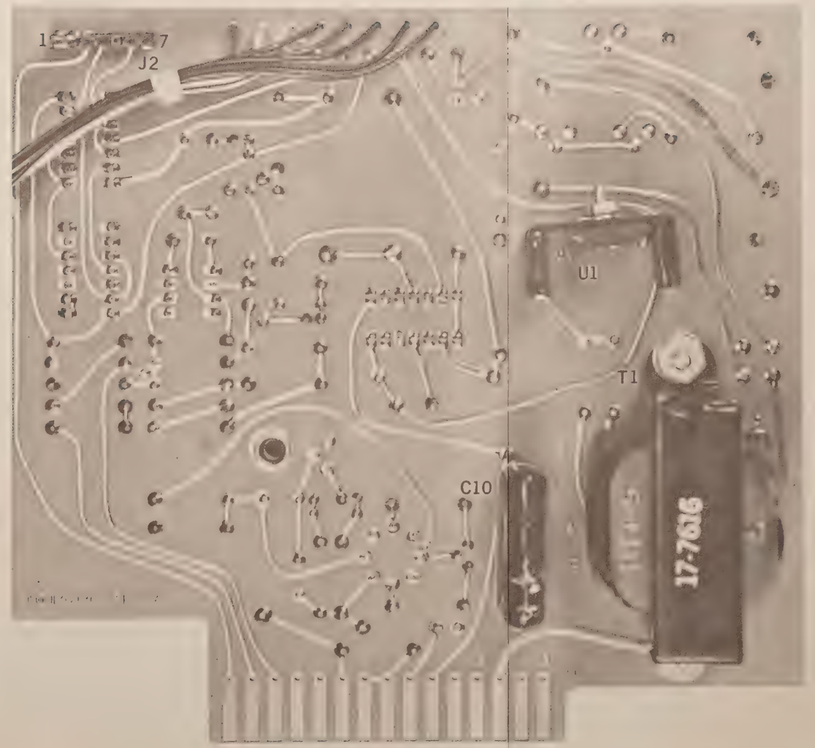
TABLE 5.4 Power Supply Voltages

METER CONNECTION	INDICATION
TP-1 [+] to TP-8 [Comm]	+5V ±0.2V.
TP-2 [–] to TP-8 [Comm]	–5V ±0.25V.
TP-3 [–] to TP-8 [Comm]	–12V ±1.2V.
TP-4 [+] to TP-8 [Comm]	+12V ±1.2V.

b) Apply a 60 Hz signal to the input of U5. On the low range, the amplifier has a gain of 2. On the high range, it has a gain of 20.
c) The RMS-DC converter produces a DC output proportional to the RMS value of input signal. Apply a signal as described in "b" above and measure the output at A1TP-6.

ABBREVIATIONS and SYMBOLS

A or Amp	= *Ampere(s)*	*p*	= *Pico, or 10 $^{-12}$*
AC	= *Alternating Current*	*Q*	= *Transistor*
C	= *Capacitor*	*Qty*	= *Quantity*
D	= *Diode*	*R*	= *Resistor*
db	= *Decibles*	*Ref*	= *Reference*
DC	= *Direct Current*	*RMS*	= *Root Mean Square*
DMM	= *Digital Multimeter*	*S*	= *Switch*
F	= *Fuse*	*Sym*	= *Symbol*
f	= *Farad*	*T*	= *Transformer*
GND	= *Ground*	*TP*	= *Test Point*
Hz	= *Hertz*	*U*	= *(IC) Internal Connector*
I	= *Indicator*	*UL*	= *Underwriters Laboratory*
J	= *Jack*	*V*	= *Volt*
K	= *Kilo, or 10 ^{3}*	*W*	= *Watt*
LED	= *Light Emitting Diode*	°	= *Degrees*
M	= *Mega, or 10 ^{6}*	°*C*	= *Degrees Centigrade*
m	= *Milli, or 10 $^{-3}$*	*μ*	= *Micro, or 10 $^{-6}$*
n	= *Nano, or 10 $^{-9}$*	Ω	= *Ohm*
P	= *Plug*		



A1 Amplifier PC Board (circuit side)

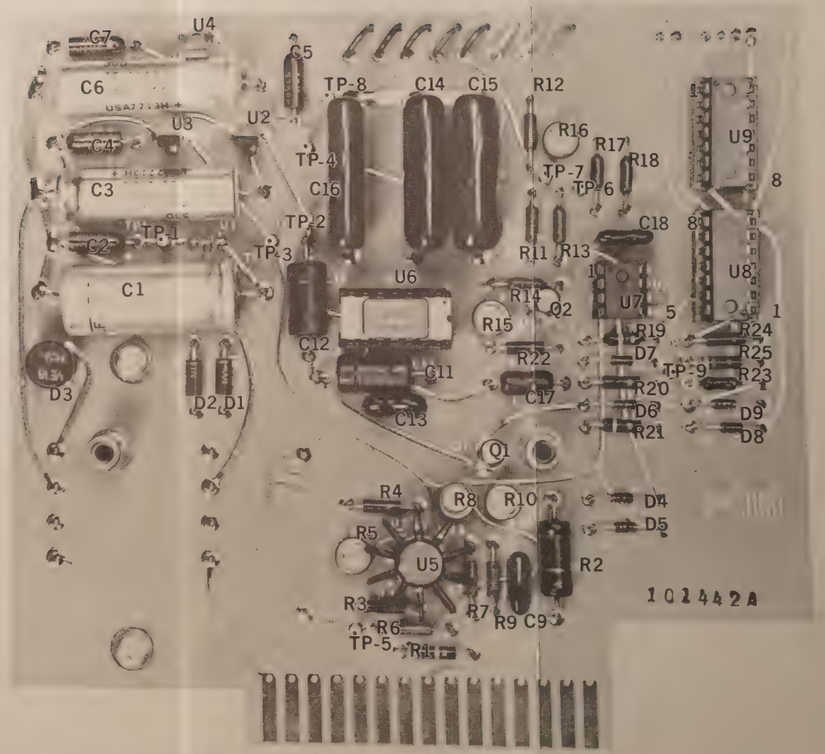


FIGURE 5.1 A1 Amplifier PC Board (component side)

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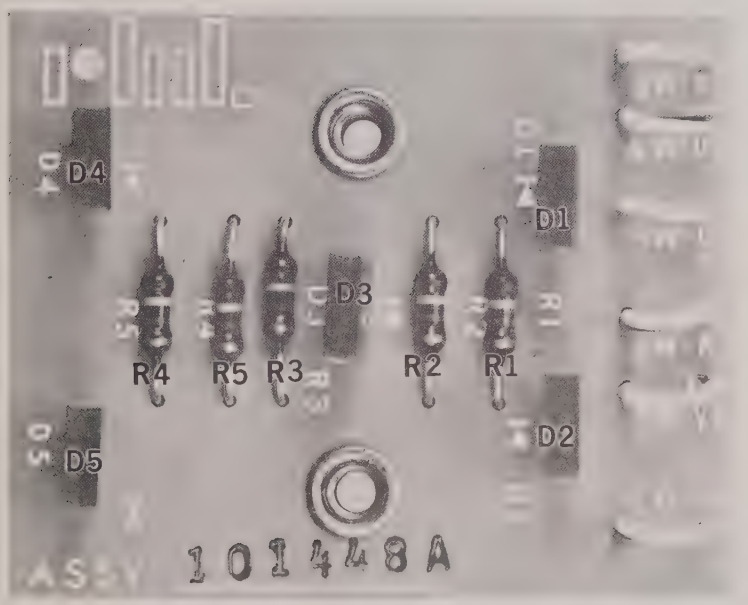
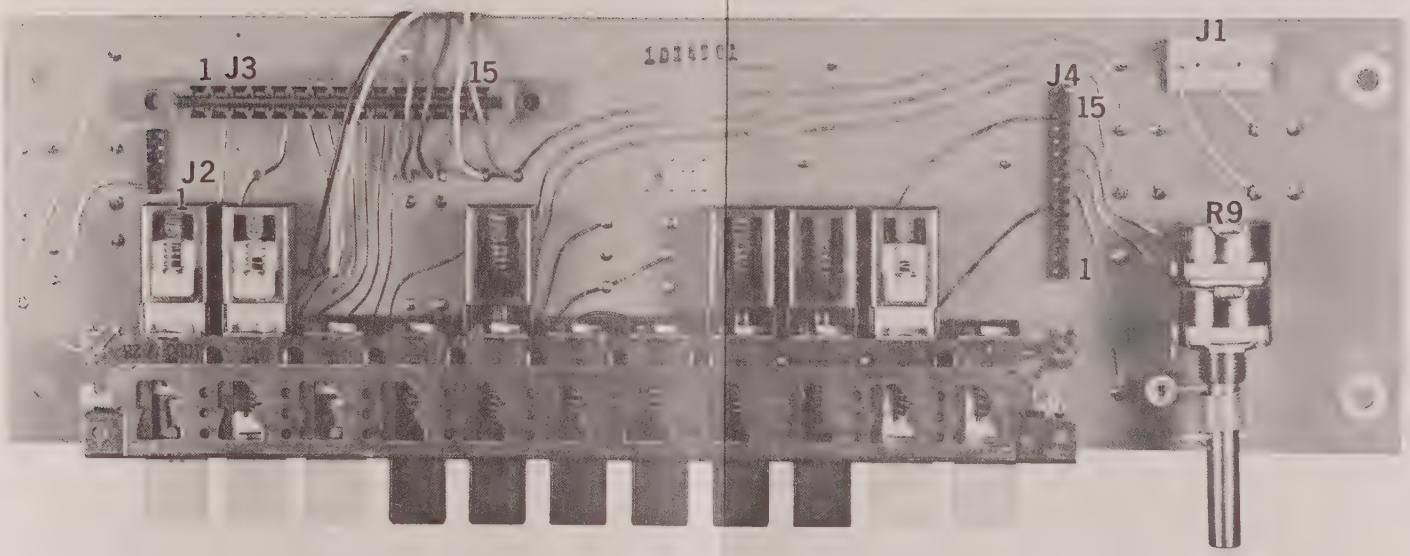


FIGURE 5.2 A2 Indicator PC Board



A3 Function PC Board (component side)

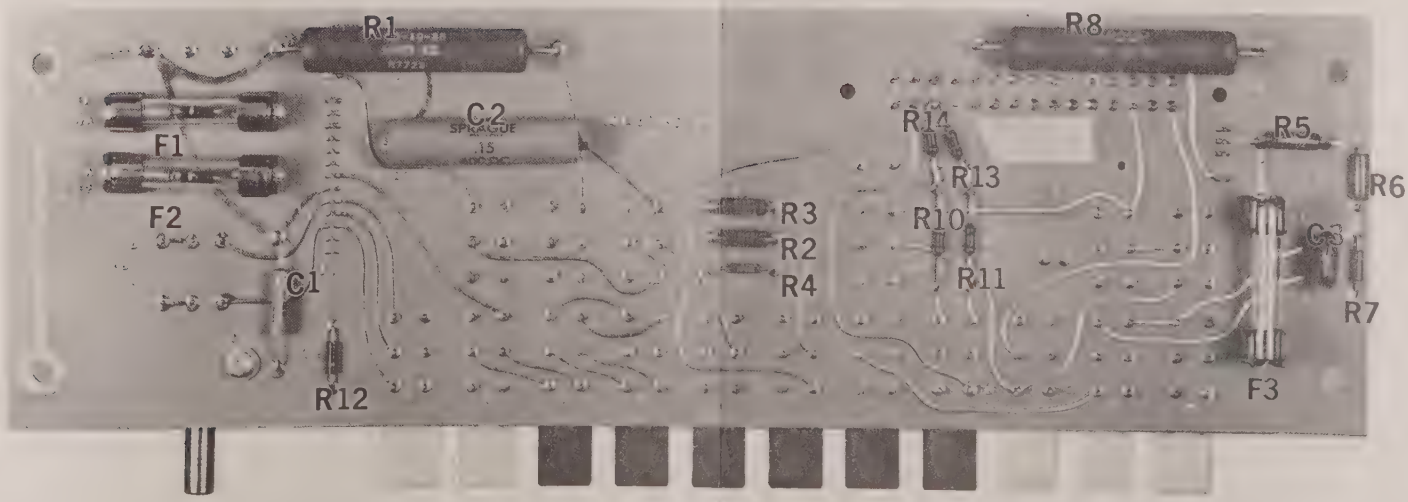


FIGURE 5.3 A3 Function PC Board (circuit side)

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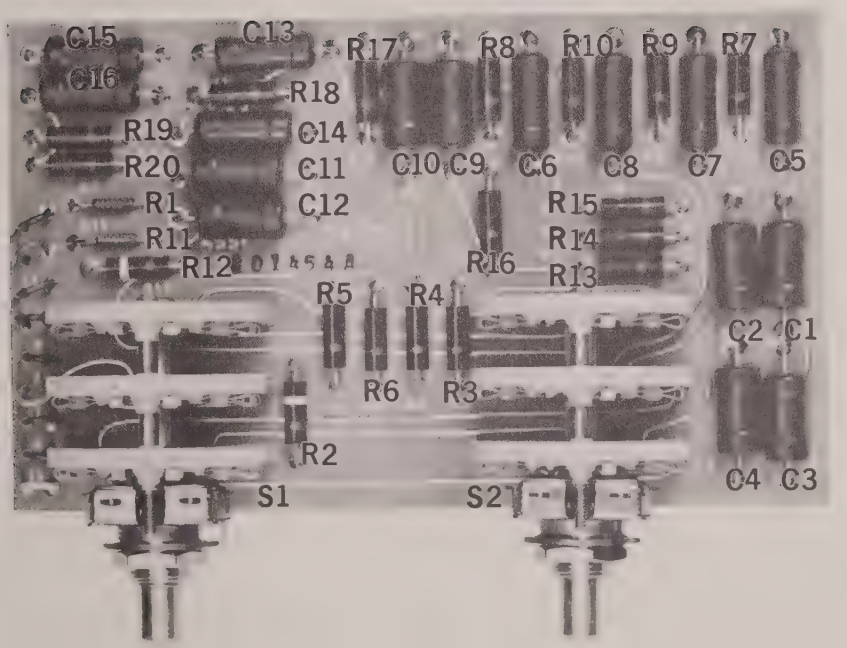


FIGURE 5.4 A4 Load PC Board

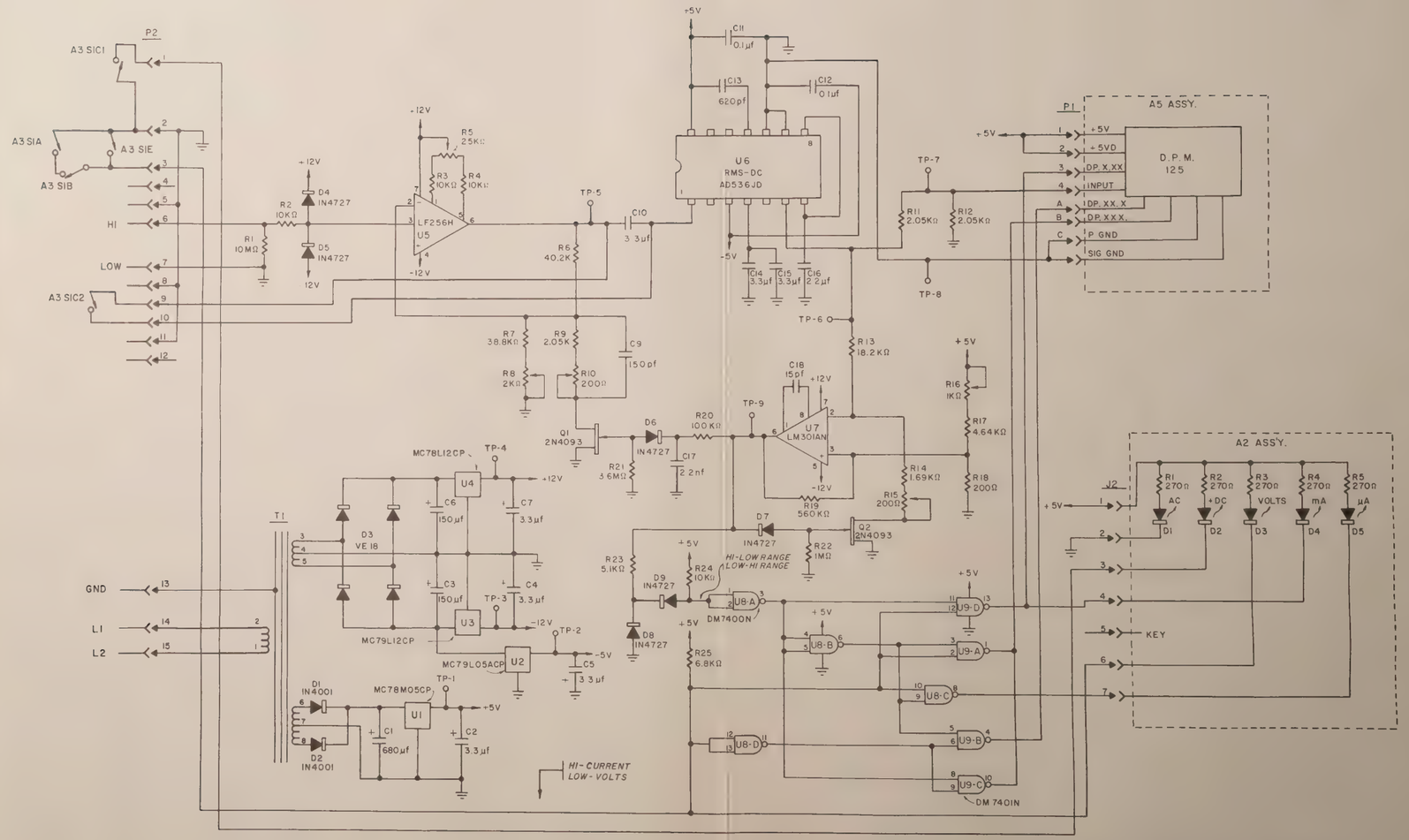
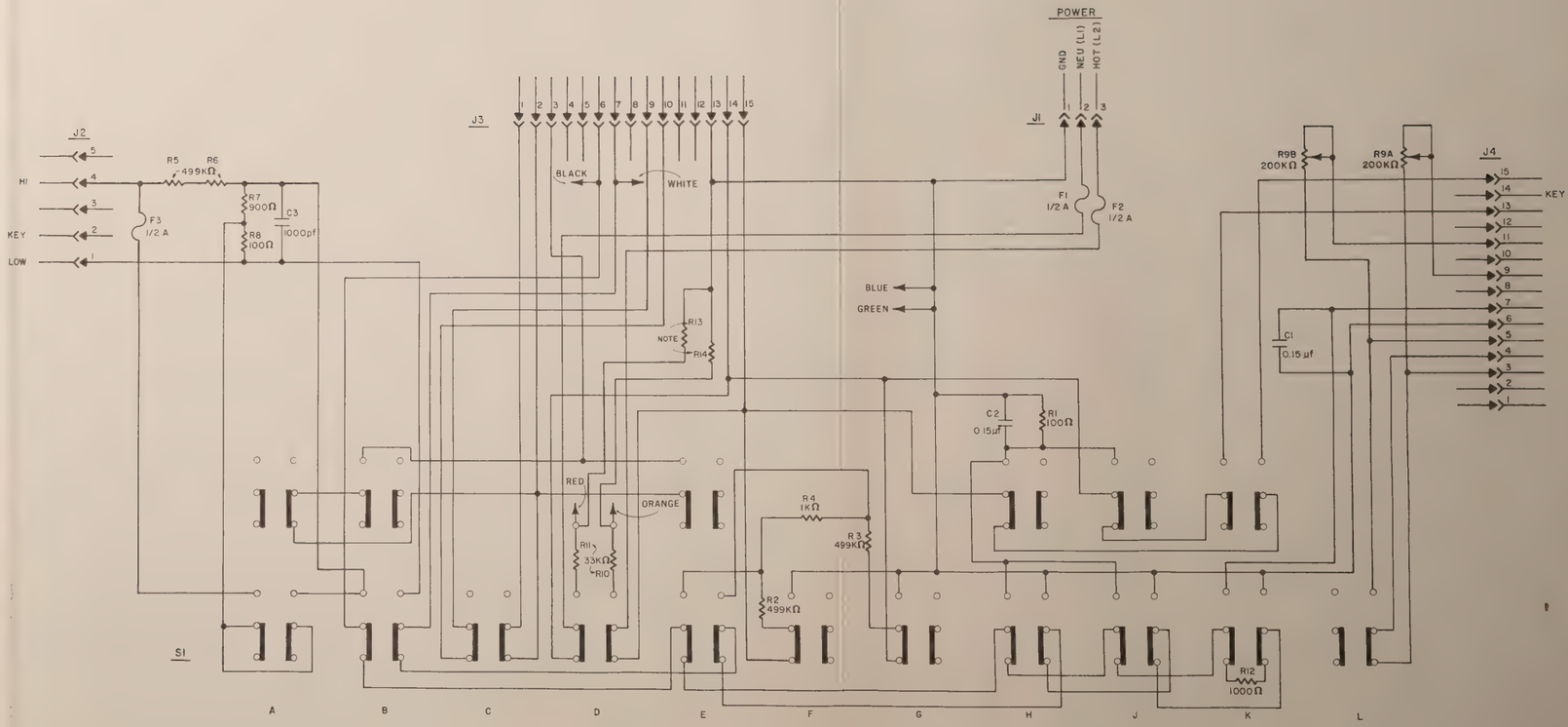


FIGURE 5.5 RMS Meter Schematic
(A1 Amplifier, A2 Indicator, and A5 Digital Readout)



NOTES

1. R13 and R14 to be factory selected for a striking voltage of 91 to 97 volts on L1 and L2 Macro Fault Indicator.

FIGURE 5.6 A3 Function Schematic

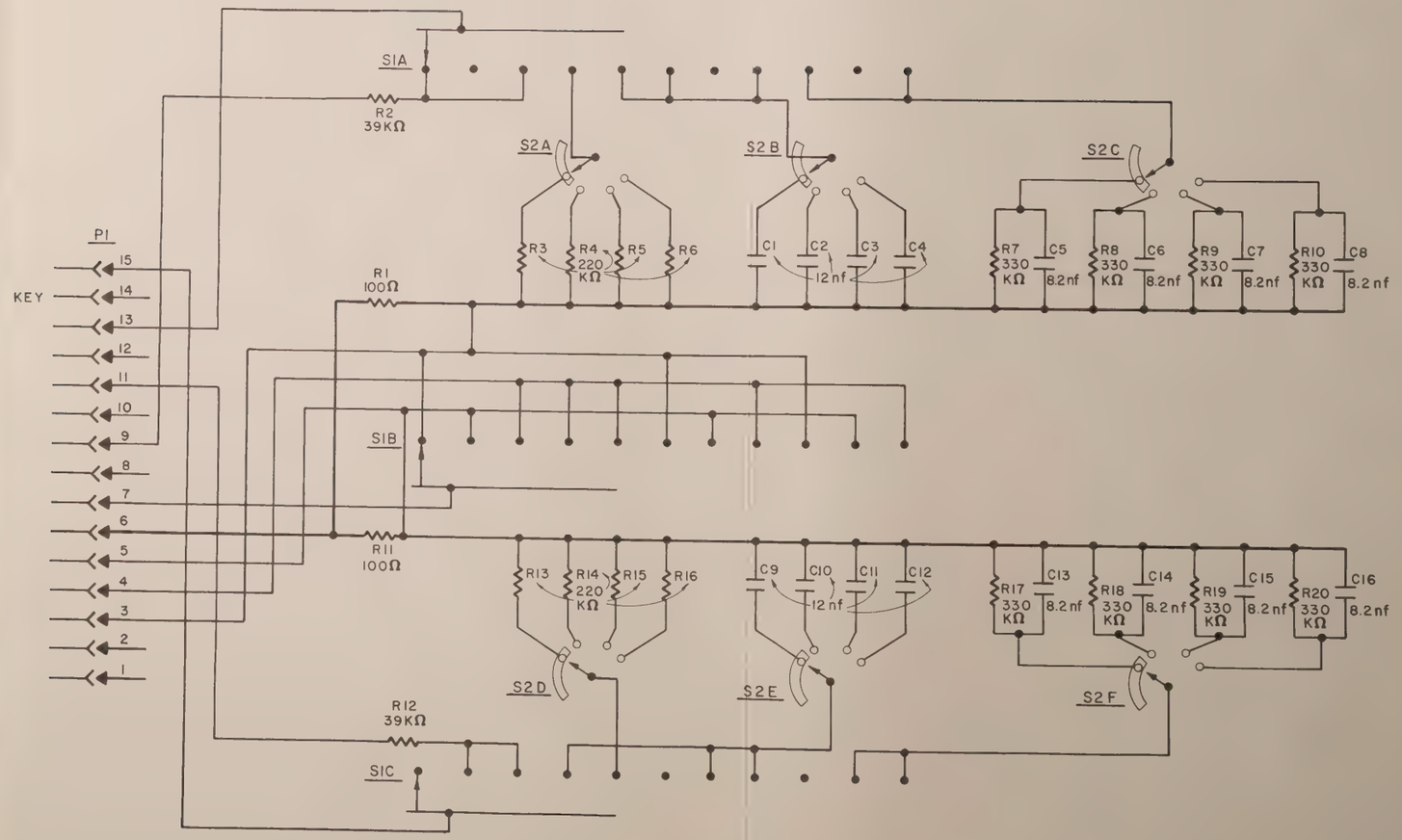


FIGURE 5.7 A4 Load Schematic

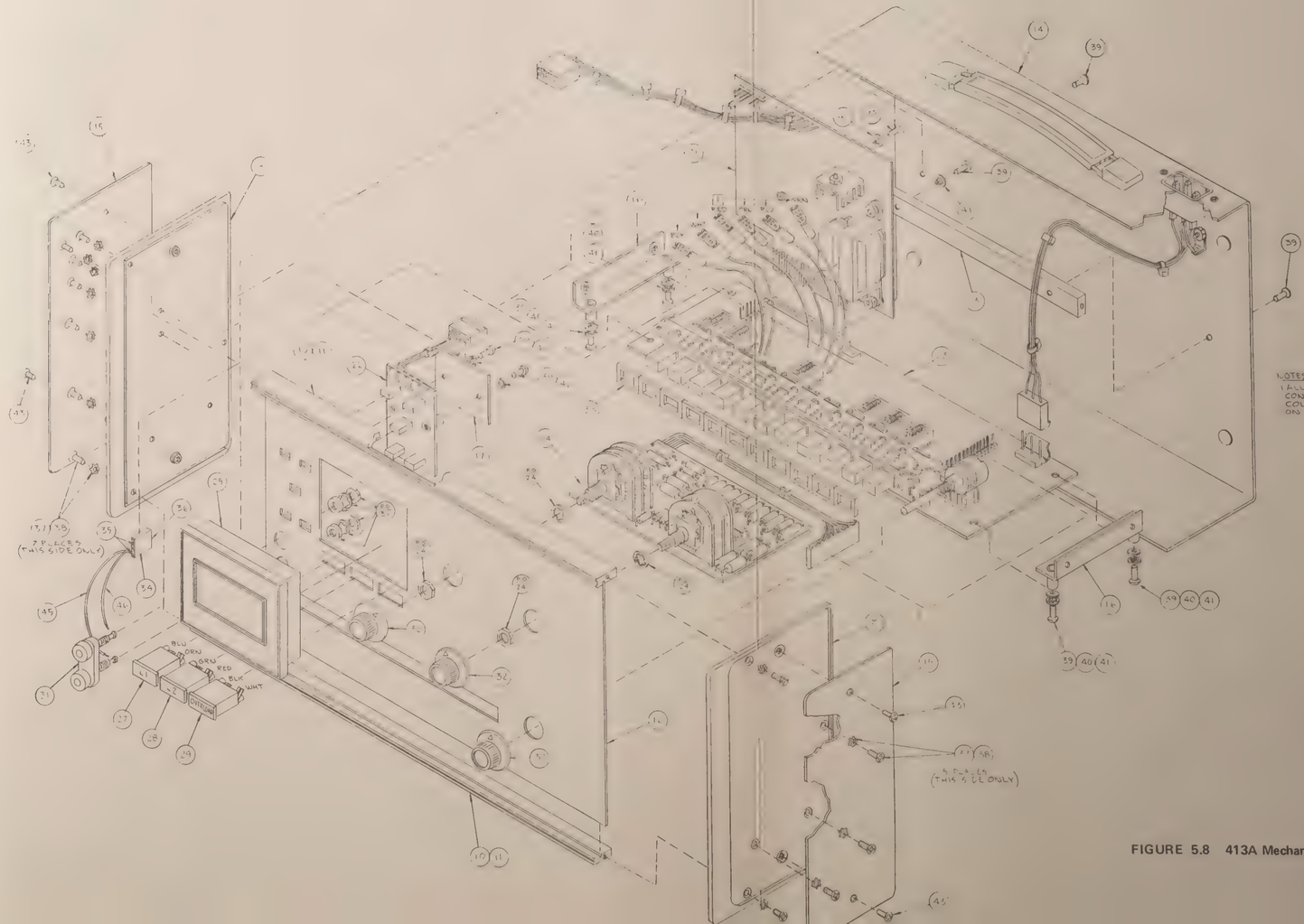


FIGURE 5.8 413A Mechanical Assembly

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replaceable parts

6.1 ■ INTRODUCTION

6.2 This section contains information for ordering replacement parts for the Model 413A Isolated Power System Analyzer.

6.3 Tables 6-1 thru 6-5 list replaceable parts in alpha-numerical order to their circuit symbols. Detailed information on a part used more than once in the instrument is listed opposite the first circuit symbol applying to the part. Other circuit symbols applying to the same part refer to the initial symbol. Detailed information includes the following:

1) Assembly
2) Circuit symbol
3) Full description of part
4) Manufacturer of part
5) Manufacturer's part number
6) Total quantity used in equipment

6.4 ■ ORDERING INFORMATION

6.5 Most of the parts listed can be obtained from local electronic part houses. If this is not feasible, or a replacement part is required that is not listed, address order or inquiry to:

CUSTOMER SERVICE
NEURODYNE-DEMPSEY, INC.
P. O. BOX 1925
CARSON CITY, NEVADA 89701

Specify the following information for each part:

1) Model and complete serial number on instrument
2) Circuit symbol
3) Manufacturer of part
4) Manufacturer's part number
5) Description

6.6 To order a part not listed in the tables, give a description of the part and include it's function and location.

TABLE 6-1 REPLACEABLE PARTS for Model 413A

REF SYM	NDI PART NO.	QTY	DESCRIPTION	MFG	MFG PART NO.
A1	5205-0047	1	Amplifier PCB Assembly	NDI	5205-0047
A2	5205-0048	1	Indicator PCB Assembly	NDI	5205-0048
A3	5205-0049	1	Function PCB Assembly	NDI	5205-0049
A4	5205-0050	1	Load PCB Assembly	NDI	5205-0050
A5	5210-0032	1	Digital Readout, Meter	Analog Devices	AD2026
I1	2401-0009	1	Indicator	NDI	2401-0009
I2	2401-0010	1	Indicator	NDI	2401-0010
I3	2401-0012	1	Indicator	NDI	2401-0012
J1	2719-0028	1	Jack, Dual Banana	Pomona	2269 Black
	4902-0024	3	Knob	Nobex	B-105-D
	4901-0001	11	Escutcheon, Black	Switchcraft	DW-102
P2	2710-0072	1	Plug	Molex	22-01-2051
	3010-0006	1	Cord, Power	Belden	17250

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TABLE 6-2 REPLACEABLE PARTS for Assembly A1

REF SYM	NDI PART NO.	QTY	DESCRIPTION	MFG	MFG PART NO.
	5201-0045	1	Amplifier PC Board	NDI	5201-0045
C1	0403-0007	1	Cap., Ele: 680μf, 16 WVDC	Mepco	ET681X016AO1
C2	0400-3691	4	Cap., Tan: 3.3μf, 15 WVDC	Kemet	T310A335-015AS
C3	0403-0002	2	Cap., Ele: 150μf, 25 WVDC	Sprague	TE-1212
C4	0400-3691		Same as C2		
C5	0400-3691		Same as C2		
C6	0403-0002		Same as C3		
C7	0400-3691		Same as C2		
C8			Not used		
C9	0415-0104	1	Cap., Mica: 150pf, ±5%	Arco	DM15-151J
C10	0410-0004	3	Cap., Est: 3.3μf, ±10%, 100 WVDC	Mepco	C280AH/A3M3
C11	0408-0021	2	Cap., Myl: 0.1μf, 80 WVDC	Sprague	192P1049R8
C12	0408-0021		Same as C11		
C13	0415-0121	1	Cap., Mica: 620pf, 300 WVDC	Arco	DM15-621J
C14	0410-0004		Same as C10		
C15	0410-0004		Same as C10		
C16	0410-0008	1	Cap., Est: 2.2μf, ±10%, 100 WVDC	Mepco	C280AH/A2M2
C17	0408-0038	1	Cap., Myl: 2.2nf, 200 WVDC	Sprague	192P22292
C18	0415-0080	1	Cap., Mica: 15pf, 500 WVDC	Arco	DM15-150J
D1	2101-0002	2	Diode		1N4001
D2	2101-0002		Same as D1		
D3	2103-0004	1	Diode, Bridge	Varo	VE-18
D4	2101-0003	6	Diode		1N4727
D5	2101-0003		Same as D4		
D6	2101-0003		Same as D4		
D7	2101-0003		Same as D4		
D8	2101-0003		Same as D4		
D9	2101-0003		Same as D4		
J2	2710-0064	1	Jack, 7 pin	Molex	22-03-2071
P1	2710-0074	2	Plug, 7 pin	Molex	22-01-2071
Q1	2114-0002	2	Tran., FET		2N4093
Q2	2114-0002		Same as Q1		
R1	0300-1107	1	Res., C.C: 10MΩ, ±5%, ¼ W		
R2	0303-1104	1	Res., C.C: 10KΩ, ±5%, 1 W		
R3	0300-1104	3	Res., C.C: 10KΩ, ±5%, ¼ W		
R4	0300-1104		Same as R3		
R5	0326-0012	1	Res., Var: 25KΩ	Helipot	62P-R25KΩ

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TABLE 6-2 REPLACEABLE PARTS for Assembly A1 (continued)

REF SYM	NDI PART NO.	QTY	DESCRIPTION	MFG	MFG PART NO.
R6	0316-0020	1	Res., M.F: 40.2KΩ, ± ½ %, 1/8 W	Corning	RN 55C
R7	0316-0021	1	Res., M.F: 38.8KΩ, ± ½ %, 1/8 W	Corning	RN 55C
R8	0326-0008	1	Res., Var: 2KΩ	Helipot	62P-R2KΩ
R9	0316-0022	3	Res., M.F: 2.05KΩ, ± ½ %, 1/8 W	Corning	RN 55C
R10	0326-0005	2	Res., Var: 200Ω	Helipot	62P-R200Ω
R11	0316-0022		Same as R9		
R12	0316-0022		Same as R9		
R13	0307-1264	1	Res., M.F: 18.2KΩ, ±1%, 1/8 W		
R14	0307-1233	1	Res., M.F: 1.69KΩ, ±1%, 1/8 W		
R15	0326-0005		Same as R10		
R16	0326-0007	1	Res., Var: 1KΩ	Helipot	62P-R1KΩ
R17	0307-1653	1	Res., M.F: 4.64KΩ, ±1%, 1/8 W		
R18	0307-1302	1	Res., M.F: 200Ω, ±1%, 1/8 W		
R19	0300-1565	1	Res. C.C: 560 KΩ, ±5%, ¼ W		
R20	0300-1105	1	Res., C.C: 100KΩ, ±5%, ¼ W		
R21	0300-1366	1	Res., C.C: 3.6MΩ, ±5%, ¼ W		
R22	0300-1106	1	Res., C.C: 1MΩ, ±5%, ¼ W		
R23	0300-1513	1	Res., C.C: 5.1KΩ, ±5%, ¼ W		
R24	0300-1104		Same as R3		
R25	0300-1683	1	Res., C.C: 6.8KΩ, ±5%, ¼ W		
T1	1201-0014	1	Power Tansformer	Triad	F168-XP
U1	2118-0015	1	IC, Pos., 5V Reg	Motorola	MC78M05CP
U2	2118-0016	1	IC, Neg., 5V Reg	Motorola	MC79L05ACP
U3	2118-0017	1	IC, Neg., 12V Reg	Motorola	MC79L12CP
U4	2118-0018	1	IC, Pos., 12V Reg	Motorola	MC78L12CP
U5	2118-0019	1	IC, Op-Amp	N.S.C.	LF256H
U6	2118-0020	1	IC, RMS-DC Con	Analog Devices	AD536
U7	2118-0001	1	IC, Op-Amp	Motorola	LM301AN
U8	2120-0004	1	IC, Quad, 2-input nand	N.S.C.	DM 7400N
U9	2120-0005	1	IC, Quad, 2-input nand	N.S.C.	DM 7401N
	2712-0003	1	IC Socket, 8 pin DIP	Amp	583640-1
	2712-0001	3	IC Socket, 14 pin DIP	Cinch	14-DIP

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TABLE 6-3 REPLACEABLE PARTS for Assembly A2

REF SYM	NDI PART NO.	QTY	DESCRIPTION	MFG	MFG PART NO.
	5201-0046	1	Indicator PC Board	NDI	5201-0046
D1	2106-0010	5	Diode, LED	Hewlett-Packard	5082-4670
D2	2106-0010		Same as D1		
D3	2106-0010		Same as D1		
D4	2106-0010		Same as D1		
D5	2106-0010		Same as D1		
P1	2710-0074	1	Plug	Molex	22-01-2071
R1	0300-1272	5	Res., C.C: 270Ω, ±5%, ¼ W		
R2	0300-1272		Same as R1		
R3	0300-1272		Same as R1		
R4	0300-1272		Same as R1		
R5	0300-1272		Same as R1		

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TABLE 6-4 REPLACEABLE PARTS for Assembly A3

REF SYM	NDI PART NO.	QTY	DESCRIPTION	MFG	MFG PART NO.
	5201-0047	1	Functional PC Board	NDI	5201-0047
C1	0408-0070	1	Cap., Myl: 0.15μf, 200 WVDC	IMB	XA2B154K
C2	0410-0005	1	Cap., Myl: 0.15μf, 400 WVDC	CDE	WMF-4P15±5%
C3	0415-0126	1	Cap., Mica: 1000pf, ±5%	Arco	DM15-102J
F1	1005-0034	2	Fuse, Slo-Blo: 3AG, ¼ A	Littlefuse	313.250
F2	1005-0034		Same as F1		
F3	1005-0011	1	Fuse: 3AG, ½ A	Littlefuse	312.500
	1006-0007	6	Fuse, Clips	Littlefuse	102068
J1	2710-0010	1	Connector, Power: 5 pin, KK156	Molex	09-65-1051
J2	2710-0062	1	Connector: KK100	Molex	22-03-2051
J3	2710-0002	1	Connector, PCB Edge: 30 pin	Cinch-Jones	50-30B-10
J4	2710-0066	1	Connector: 15 pin, KK100	Molex	22-03-2151
R1	0320-0019	2	Res., W.W: 100Ω, ±0.5%, 10 W	Dale	RS-10-38
R2	0316-0010	4	Res., M.F: 499KΩ, ±0.5%, ¼ W	Corning	RN60C
R3	0316-0010		Same as R2		
R4	0316-0011	1	Res., M.F: 1KΩ, ±0.5%, 1/8 W	Corning	RN55C
R5	0316-0010		Same as R2		
R6	0316-0010		Same as R2		
R7	0316-0012	1	Res., M.F: 900Ω, ±0.5%, 1/8 W	Corning	RN55C
R8	0320-0019		Same as R1		
R9	0326-0106	1	Res., Var: Dual 200KΩ	NDI	0326-0106
R10	0300-1334	2	Res., C.C: 33KΩ, ±5%, ¼ W		
R11	0300-1334		Same as R10		
R12	0300-1103	1	Res., C.C: 1000Ω, ±5%, ¼ W		
R13		1	Factory Selected		
R14		1	Factory Selected		
S1	2505-0015	1	Switch, P.B.	NDI	2505-0015

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TABLE 6-5 REPLACEABLE PARTS for Assembly A4

REF SYM	NDI PART NO.	QTY	DESCRIPTION	MFG	MFG PART NO.
	5201-0048	1	Load PC Board	NDI	5201-0048
C1	0408-0064	8	Cap., Myl: 12nf, ±10%, 400 V	Sprague	192P-12394
C2	0408-0064		Same as C1		
C3	0408-0064		Same as C1		
C4	0408-0064		Same as C1		
C5	0408-0065	8	Cap., Myl: 8.2nf, ±10%, 400 V	Sprague	192P-82294
C6	0408-0065		Same as C5		
C7	0408-0065		Same as C5		
C8	0408-0065		Same as C5		
C9	0408-0064		Same as C1		
C10	0408-0064		Same as C1		
C11	0408-0064		Same as C1		
C12	0408-0064		Same as C1		
C13	0408-0065		Same as C5		
C14	0408-0065		Same as C5		
C15	0408-0065		Same as C5		
C16	0408-0065		Same as C5		
P1	2710-0076	1	Plug: 15 pin	Molex	22-01-2151
R1	0316-0023	2	Res., M.F: 100Ω, ±0.5%, 1/8 W	Corning	RN 55C
R2	0301-1394	2	Res., C.C: 39KΩ, ±5%, ½ W		
R3	0301-1225	8	Res., C.C: 220KΩ, ±5%, ½ W		
R4	0301-1225		Same as R3		
R5	0301-1225		Same as R3		
R6	0301-1225		Same as R3		
R7	0301-1335	8	Res., C.C: 330KΩ, ±5%, ½ W		
R8	0301-1335		Same as R7		
R9	0301-1335		Same as R7		
R10	0301-1335		Same as R7		
R11	0316-0023		Same as R1		
R12	0301-1394		Same as R2		
R13	0301-1225		Same as R3		
R14	0301-1225		Same as R3		
R15	0301-1225		Same as R3		
R16	0301-1225		Same as R3		
R17	0301-1335		Same as R7		
R18	0301-1335		Same as R7		
R19	0301-1335		Same as R7		
R20	0301-1335		Same as R7		
S1	2501-0016	1	Switch, Load	NDI	2501-0016
S2	2501-0015	1	Switch, Fault	NDI	2501-0015

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TABLE 6-6 MACHANICAL PARTS LIST

Fig. & Index No.	NDI Part No.	Serial/Model No. Eff.	Disc.	Qty.	Description
5-8	5215-0013			1	Right End Plate Assembly
-9	5215-0014			1	Left End Plate Assembly
-10	5015-0061			2	Side Rail
-11	5008-0078			2	Trim Insert
-12	5001-0068			1	Front Panel
-13	5015-0062			1	Rear Brace
-14	5215-0015			1	Case Assembly
-15	5008-0076			2	Dress Cover
-16	5215-0017			2	A3 PCB Bracket Assembly
-17	5215-0016			1	A2 PCB Bracket Assembly
-18					
-19					
-20					
-21	5205-0047			1	A1 Amplifier PCB Assembly
-22	5205-0048			1	A2 Indicator PCB Assembly
-23	5205-0049			1	A3 Function PCB Assembly
-24	5205-0050			1	A4 Load PCB Assembly
-25	5210-0032			1	A5 Digital Readout
-26					
-27	2401-0009			1	Indicator
-28	2401-0010			1	Indicator
-29	2401-0012			1	Indicator
-30					
-31	2719-0028			1	Jack; Dual Banana
-32	4902-0024			3	Knob
-33	4901-0001			11	Escutchen; Black
-34	2710-0072			1	Plug
-35	2716-0036			2	Terminals
-36	2710-0080			1	Polarizing Key
-37	4704-0435			12	Screw; Flathead, 6-32 x 3/8" L
-38	4711-0719			12	Lockwasher; Countersunk, #6
-39	4704-2435			10	Screw; Panhead, 6-32 x 3/8" L
-40	4711-4019			4	Flat Washer; #6
-41	4711-0119			8	Lockwasher; #6
-42					
-43	4704-0234			4	Screw; Flathead, 4-40 x 5/16" L
-44					
-45	3003-0500			1	Wire; #24, Black, 3" L
-46	3003-0502			1	Wire; #24, Black, 3" L

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APPENDIX

ISOLATED POWER SYSTEM TESTS For 413A Only

HOSPITAL or FIRM | SUPPLY TYPE | AREA LOCATION | SHEET | AUTHORIZED SIGNATURE

TEST									
MACRO	L1-LIGHT	1 (circle one) ON	OFF	ON	OFF	ON	OFF	ON	OFF
FAULT	L2-LIGHT	ON	OFF	ON	OFF	ON	OFF	ON	OFF
LINE VOLTAGE	L1 - GND	2 _____ V AC		_____ V AC		_____ V AC		_____ V AC	
		_____ V AC		_____ V AC		_____ V AC		_____ V AC	
		_____ V AC		_____ V AC		_____ V AC		_____ V AC	
HAZARD CURRENT TO GROUND	L1 - GND	3 _____ μA - mA		_____ μA - mA		_____ μA - mA		_____ μA - mA	
	L2 - GND	_____ μA - mA		_____ μA - mA		_____ μA - mA		_____ μA - mA	
VARIABLE FAULT SYSTEMS	VAR RES	L1	4 _____ mA (trip level)	_____ KΩ _____ mA (trip level)		_____ KΩ _____ mA (trip level)		_____ KΩ _____ mA (trip level)	
		L2	_____ mA (trip level)	_____ KΩ _____ mA (trip level)		_____ KΩ _____ mA (trip level)		_____ KΩ _____ mA (trip level)	
		BAL (L1)	_____ KΩ _____ mA (trip level)	_____ KΩ _____ mA (trip level)		_____ KΩ _____ mA (trip level)		_____ KΩ _____ mA (trip level)	
	HYBRID R-C		5						
		R on L2	A B C D _____ μA - mA	A B C D _____ μA - mA		A B C D _____ μA - mA		A B C D _____ μA - mA	
		C on L1	A B C D _____ μA - mA	A B C D _____ μA - mA		A B C D _____ μA - mA		A B C D _____ μA - mA	
	C or R		6						
	R-L-C HYBRID		7						
GEN	ALARM		8						
	ALARM								
	REMOTE								
	SILENCING SWITCH		OK _____ NO _____	OK _____ NO _____		OK _____ NO _____		OK _____ NO _____	

uncompromising product excellence

Printed in U.S.A. Form 413A-SS 1026

Initial Set-up Procedure

ISOLATED POWER SYSTEM ANALYZER, Model 413A

First: MACRO FAULT TEST

Connect 413A's power cord to the Isolated Power System under test.

[redacted]

Depress PWR OFF & MACRO FAULT pushbutton. If either L1 or L2 indicators illuminate, a possible macro-fault condition exists. Consult your 413A manual, paragraph 3.6, before proceeding. Record condition of indicators at 1 on form.

Second: LINE VOLTAGE MEASUREMENTS

With the AC+DC pushbutton out, depress the L1 - L2 pushbutton and read true RMS voltage (AC+DC) between lines 1 and 2. Record reading at 2 on form. Depress L1 - GND and L2 - GND in sequence to measure true RMS voltages from the individual lines to reference ground. Record readings on form. (NOTE: At any time the AC+DC pushbutton may be depressed to read true RMS AC voltage only.)

Third: HAZARD CURRENT TEST

In sequence depress the L1 HAZ and L2 HAZ pushbuttons to measure maximum hazard from each line. Record readings at 3 on form.

Fourth: VARIABLE FAULT TEST (VARIABLE RESISTANCE)

Depress the VAR FAULT pushbutton and select L1 VAR RES with FAULT TYPE selector switch. Rotate VAR RES FAULT KΩ control CCW while observing digital readout reading. When Isolated Power System alarm sounds, record reading and VAR RES FAULT KΩ reading at 4 on form. Select L2 with FAULT TYPE selector switch and repeat test. Record readings. Select BAL* with FAULT TYPE selector switch.

[redacted]

Rotate VAR RES FAULT KΩ control CCW. When Isolated Power System alarm sounds, note both digital readout reading and the VAR RES FAULT KΩ control reading at 4 BAL (L1). Depress white pushbutton L2. Rotate VAR RES FAULT KΩ control CCW until Isolated Power System alarm sounds. Record both digital readout readings and the VAR RES FAULT KΩ reading at 4 BAL (L2).

Fifth: VARIABLE FAULT TEST (Series HYBRID R-C)

5a) Depress VAR FAULT pushbutton and select HYBRID R-C, R on L1* with FAULT TYPE selector switch.

5b) Starting at position A rotate the FAULT MAGNITUDE selector switch CW. When the Isolated Power System alarm sounds, record readout reading at 5 on form and circle letter corresponding to position of FAULT MAGNITUDE selector switch when alarm sounded.

5c) Depress the white L2 pushbutton and repeat test to obtain measurements with R on L2. Record readings at 5 on form.

5d) Advance FAULT TYPE selector switch CW to C on L1* and repeat steps 5b and 5c. Record readings at 5 on form.

Sixth: VARIABLE FAULT TEST (CAP)

Rotating the FAULT TYPE selector switch in successive steps CW, repeat steps 5b and 5c to obtain readings with capacitive faults. Record reading at 6 on form.

Seventh: VARIABLE FAULT TEST (R II C HYBRID)

Rotate the FAULT TYPE selector switch CW through successive R II C HYBRID positions, repeat the procedures used in steps 5b and 5c to obtain readings with R II C HYBRID faults. Record reading at 7 on form.

Eighth: ADDITIONAL NOTES

Spaces are provided to check other parameters of the Isolated Power System that may be of interest.

DAMAGE & SHORTAGE

Before you fully unpack any unit READ THIS for your protection

(THIS INFORMATION APPLIES ONLY ON SHIPMENTS WITHIN THE UNITED STATES)

DAMAGE This shipment was packaged and delivered to the carrier with the utmost care to insure safe delivery of goods. When shipment is received and signed for by the transportation company, consignor's responsibility ceases. Do not accept shipment which evidences damage or shortage until agent of carrier endorses a statement of the irregularity on the face of the transportation receipt. Without documentary evidence, claim cannot be filed.

CONCEALED DAMAGE Interstate Commerce Commission has indicated that a carrier is as much responsible for concealed damage as for visible damage in transit. Upon receipt of shipment, promptly unpack and check thoroughly. If concealed damage is discovered, cease further unpacking and request immediate inspection by local agent of carrier. A written report of the agent's findings, with his signature, is necessary to support claim.

SHORTAGE Check shipment against shipping papers. Do not discard packing materials or packing cases until contents have been found to be correct. The removal of badly needed items, before shipment has been checked, may create a shortage. Check all possibilities before reporting a shortage.

CLAIMS If your agent or carrier has been given an opportunity to inspect the shipment, any claim for a shortage or damaged merchandise can be handled as a simple and routine procedure. Claims must be filed by consignee. Shipping terms are f.o.b. Carson City, Nevada.

LOSS In the event of complete loss, claim will be handled in the same manner as for Shipping Damage or Shortage.

**Note further information below.*

SHIPPING DAMAGE OR SHORTAGE

AIR FREIGHT – Claim must be initiated at point of destination. Claim must be filed by submitting a letter on company stationery with an explanation of the extent of damage or loss and forwarded with a copy of the original* air bill, and original invoice or photostat of same, to the airline having carried the shipment.

*Upon request certified photostatic copies of original papers held by Neurodyne-Dempsey, Inc. required in support of claims will be made available.

PARCEL POST / UPS

PLACING CLAIM FOR DAMAGE – For those shipments insured by Parcel Post, the addressee initiates the claim by filling out Post Office Dept. Form 3812, "Request for Payment of Domestic Postal Insurance". Item 12 is to be other than Neurodyne-Dempsey, Inc. Damaged material must be returned to the Post Office of address for inspection. A new purchase order is required by Neurodyne-Dempsey, Inc. to cover the cost of repairs (or in the case of loss or refiling-replacement order). Damaged material will be repaired and returned. Party named in item 12 of form 3812 will receive reimbursement for repair cost from Post Office Department.

PLACING CLAIM FOR LOSS – In the event of a report to consignor of loss or refiling, Post Office Dept. Form 3812 will be initiated by Neurodyne-Dempsey, Inc. at point of origin. If, after Post Office investigation, the material is not located, disposition from this point will be the same as stated in the above paragraph—"Placing claim for damage."

PLACING CLAIM FOR DAMAGE TO SHIPMENTS BY UNITED PARCEL—The addressee must notify Neurodyne-Dempsey, Inc. who will notify United Parcel Service giving the shipper's number and date parcel was shipped. United Parcel Service will send a representative to inspect the damage and advise proper disposition. A new purchase order is required by Neurodyne-Dempsey Inc. to cover the cost of repairs or in the case of loss or refiling, a replacement order. Damaged material will be repaired and returned.

DATA SHEET 1003 - 1/78

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